

PRELIMINARY DATA SUMMARY

February 1987

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

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CERC Field Research Facility
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Field Research Facility Measurement and Analysis Work Unit at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility in Duck, North Carolina. The data were collected and the analyses performed by the FRF staff. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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I. INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Fig.1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The FRF consists of a 561-m (1,840 ft) long concrete research pier supported on 0.91 m (3 ft) diameter steel piles. The pier deck is 6.1 m (20 ft) wide, 7.74 m (25.4 ft) above mean sea level (MSL), and extends from behind the dunes to approximately the 7.6 m (25 ft) depth contour. In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Most of the data are daily observations or the results of preliminary data analysis. In many instances, continuous analog records and more extensive analyses will be made available later by the CERC Coastal Engineering Information and Analysis Center (CEIAC).

Table 1 is a list of instruments used, their status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depth at the wave gages and current meters vary and may best be determined from the information contained in Figure 8. Other installation information is contained in Table 1. All times unless otherwise specified are referenced to Eastern Standard Time (EST).

Section II presents the meteorological data; Sections III through VI, oceanographic data; Section VII, nearshore profiles and bathymetry; and Section VIII, if included, documents special events that occurred at the FRF during the month.

Questions and/or comments concerning the data may be directed to Mr. Herman C. Miller at (919) 261-3511.

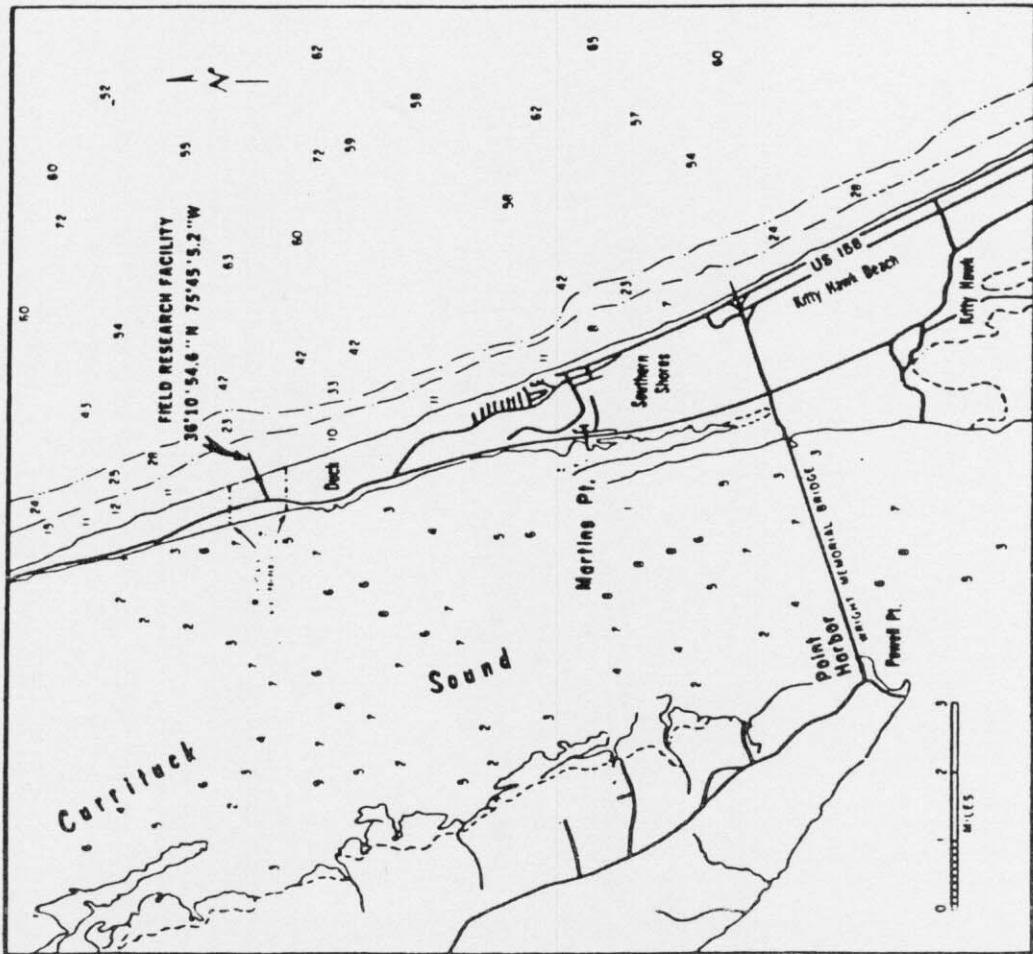
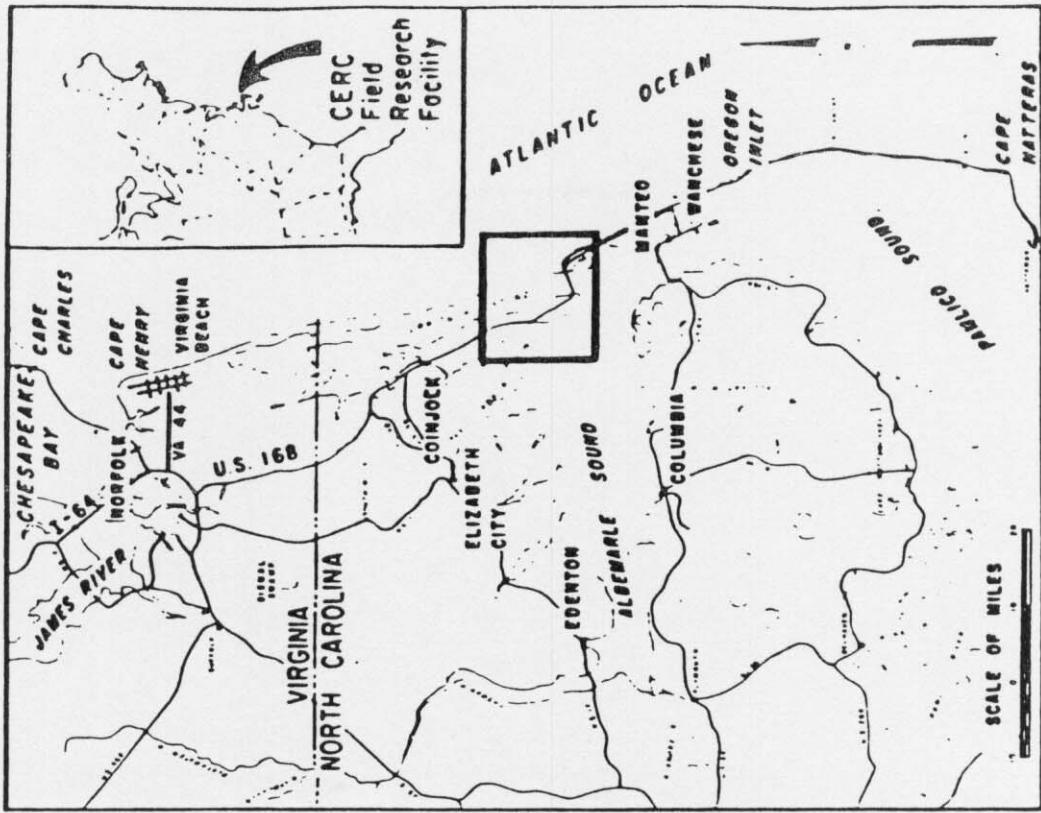


Figure 1. FRF Location Map

TABLE I
INSTRUMENT STATUS/DATA AVAILABILITY

February 1987

Instrument Status: Operational - Daily Observation: YES
 Date Collected: ALL • SOME ■
 Analog Record: ALL ■. PARTIAL
 Preliminary Analysis: ALL ■. SOME

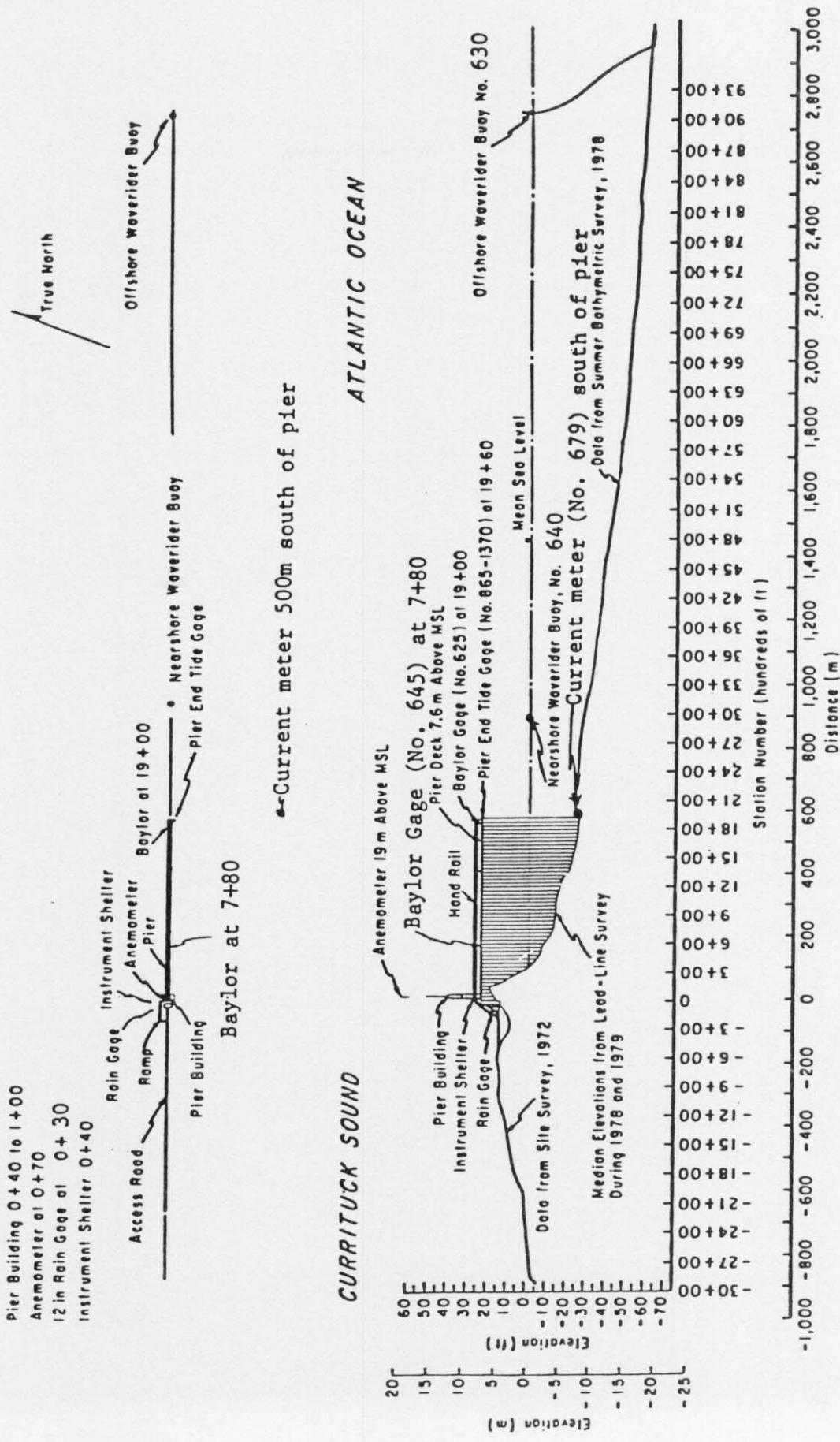


Figure 2. Instrument locations at FRF.

II. METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Fig. 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

The wind measurements are obtained from a Weather Measure Skyvane located on the FRF laboratory building (Fig. 2), 19.1 m above mean sea level (MSL).

The high and low temperatures are obtained from daily readings of NWS maximum and minimum thermometers and represent the extreme temperature values since the last reading.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in) -
 $mm \times .03937 = in$
2. Millibars (mb) to inches of mercury (in Hg) -
 $mb \times 0.02953 = in Hg$
3. Degrees Celcius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

TABLE 2: Meteorological Data

FEB 1987

Day	Hour	Wind Speed (m/s)	Wind Direction (deg TN)	Temperature (deg C)	Atm Pressure (mb)	Precipitation (mm)
1	100	7	299	1.4	1016.3	0
	700	4	302	-0.2	1018.3	0
	1300	3	194	5.8	1017.3	0
	1900	4	194	4.9	1014.3	0
2	100	4	212	5.2	1011.9	0
	700	6	233	7.0	1009.2	0
	1300	5	249	8.0	1007.5	0
	1900	1	86	5.5	1005.1	0
3	100	3	244	6.5	1004.4	0
	700	5	261	4.2	1008.9	0
	1300	3	248	6.0	1008.5	0
	1900	3	254	8.0	1011.6	0
4	100	4	340	5.0	1016.6	0
	700	5	356	4.1	1021.0	0
	1300	5	10	6.2	1023.4	0
	1900	0		2.6	1024.8	0
5	100	5	306	4.1	1026.5	0
	700	11	8	2.6	1031.9	0
	1300	7	14	3.7	1032.6	0
	1900	2	35	2.4	1032.2	0
6	100	0		-0.4	1030.9	0
	700	1	36	2.7	1027.8	0
	1300	3	106	7.9	1025.4	0
	1900	5	50	5.5	1022.4	0
7	100	3	98	6.3	1018.3	0
	700	4	29	7.4	1013.3	0
	1300	6	360	6.1	1009.5	0
	1900	4	338	5.7	1011.6	0
8	100	3	15	4.0	1012.2	0
	700	3	155	2.2	1010.2	0
	1300	5	165	10.7	1003.8	0
	1900	5	188	10.1	997.7	0
9	100	9	325	2.5	1001.1	0
	700	10	298	-1.5	1006.5	0
	1300	14	303	1.8	1008.2	0
	1900					
10	100					
	700	7	294	0.9	1023.7	0
	1300	6	236	5.6	1021.4	0
	1900	4	265	4.8	1021.4	0
11	100	3	318	2.3	1022.1	0
	700	1	15	2.7	1022.7	0
	1300	2	243	9.3	1020.4	0
	1900	3	165	3.9	1019.0	0
12	100	3	191	5.1	1016.0	0
	700	4	187	6.1	1010.9	0
	1300	4	208	9.7	1003.8	0
	1900	7	349	7.9	1006.5	0
13	100	7	337	5.3	1012.2	0
	700	2	283	2.6	1015.3	0
	1300	8	19	6.4	1016.3	0
	1900	5	53	4.5	1016.6	0
14	100	3	98	4.1	1016.6	0
	700	4	82	4.8	1014.6	0
	1300	2	41	7.1	1012.9	0
	1900	3	21	6.3	1010.9	0
15	100	4	351	4.7	1013.3	0
	700	12	19	3.8	1015.6	0
	1300	11	21	1.8	1020.0	0
	1900	9	22	-0.1	1021.4	0
16	100	13	16	-0.9	1023.7	0
	700	11	41	-0.8	1021.4	0
	1300	11	41	1.1	1019.0	0
	1900	12	42	4.8	1011.2	6
17	100	15	42	6.0	1005.8	4
	700	17	22	4.4	1006.1	13
	1300	13	9	4.3	1008.5	4
	1900	13	4	2.8	1012.2	0
18	100	10	5	3.3	1012.2	0
	700	7	331	1.0	1013.9	0
	1300	7	353	3.6	1015.6	0
	1900	6	360	3.1	1019.3	0
19	100	4	311	1.8	1021.4	0
	700	8	7	2.3	1024.8	0
	1300	8	12	2.4	1026.5	0
	1900	6	2	2.3	1028.2	0
20	100	4	351	1.5	1028.8	0
	700	7	20	3.2	1029.5	0
	1300	7	8	3.8	1028.8	0
	1900	4	25	2.8	1027.5	0

TABLE 2: Meteorological Data

FEB 1987

Day	Hour	Wind Speed (m/s)	Wind Direction (deg TN)	Temperature (deg C)	Atm Pressure (mb)	Precipitation (mm)
21	100	3	358	2.8	1025.8	0
	700	4	27	3.2	1023.4	0
	1300	5	11	3.6	1022.1	0
	1900	6	25	2.6	1021.7	0
22	100	5	26	2.8	1021.4	0
	700	3	17	3.1	1021.0	0
	1300	5	15	4.8	1018.3	0
	1900	8	60	5.6	1009.9	3
23	100	5	199	12.2	997.3	14
	700	13	303	3.3	1001.7	0
	1300	11	327	7.2	1012.6	0
	1900	3	350	4.5	1018.3	0
24	100	5	342	3.9	1022.4	0
	700	4	338	2.7	1024.8	0
	1300	5	2	6.0	1026.1	0
	1900	0		3.3	1026.1	0
25	100	2	331	3.2	1026.8	0
	700	7	10	3.6	1027.5	0
	1300	7	1	4.3	1028.8	0
	1900	4	337	3.0	1029.8	0
26	100	7	19	3.3	1029.8	0
	700	8	14	3.2	1031.2	0
	1300	8	358	4.0	1032.6	0
	1900	5	13	2.8	1032.6	0
27	100	7	27	3.4	1031.2	0
	700	7	25	3.9	1031.2	0
	1300	7	32	4.6	1030.5	0
	1900	7	13	4.4	1030.5	0
28	100	7	52	5.6	1028.2	0
	700	10	85	6.5	1025.4	0
	1300	5	105	7.7	1024.8	0
	1900	5	135	6.3	1021.0	0

III. WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645) and two Waverider buoys (Gages 630 and 640) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hrs near 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for 34 minutes.

Wave height (H_{mo}) is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. The wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. The period (T_p) is that associated with the maximum energy density in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed for all data records collected. Figure 3 is a time history of the H_{mo} and T_p values for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

TABLE 3: WAVE DATA

Part 1

FEB 1987

Day	Hour	645		625		640		630	
		Baylor at 7+80 Hmo(m)	T(sec)	Baylor at 19+00 Hmo(m)	T(sec)	Nearshr Hmo(m)	Wvrdr T(sec)	Farshr Hmo(m)	Wvrdr T(sec)
1	01	1.31	6.40	1.39	7.11	1.36	6.40	1.81	6.74
	07	1.21	5.95	1.30	7.76	1.39	8.26	1.60	6.92
	13	1.06	5.69	1.08	7.76	1.09	6.92	1.25	6.74
	19	0.66	5.33	0.78	7.11	0.84	7.76	1.03	6.92
2	01	0.37	10.66	0.58	10.24	0.58	9.84	0.65	9.84
	07	0.33	10.24	0.46	10.66	0.44	10.24	0.55	10.24
	13	0.27	10.24	0.45	10.24	0.44	10.24	0.58	10.24
	19	0.29	6.92	0.47	10.66	0.46	10.66	0.56	10.66
3	01	0.42	7.76	0.50	9.84	0.45	10.24	0.56	10.66
	07	0.29	15.06	0.51	15.06	0.52	10.24	0.62	10.66
	13	0.35	15.06	0.51	15.06	0.53	14.22	0.60	9.48
	19	0.33	15.06	0.44	13.48	*		0.52	8.53
4	01	0.36	2.59	0.50	13.48	*		0.61	10.24
	07	0.48	2.81	0.58	12.80	*		0.65	8.83
	13	0.93	4.92	1.06	5.56	1.14	6.09	1.14	6.09
	19	0.75	4.57	0.73	5.69	0.75	5.22	0.75	5.22
5	01	0.41	5.22	0.50	5.69	0.51	5.82	0.51	5.82
	07	1.25	5.95	1.49	5.82	1.43	5.82	1.42	5.82
	13	1.24	6.40	1.28	6.09	1.29	6.40	1.28	6.40
	19	0.87	5.69	0.82	5.33	0.84	6.24	0.84	6.24
6	01	0.57	5.82	0.69	7.76	0.72	7.32	0.72	7.32
	07	0.43	4.34	0.59	7.11	0.60	6.24	0.60	6.24
	13	0.31	5.12	*		0.54	6.40	0.53	6.40
	19	*		0.45	5.82	0.44	6.09	0.45	6.09
7	01	0.27	4.92	0.40	7.11	0.41	8.53	0.41	8.53
	07	0.26	4.74	0.46	8.53	0.48	8.53	0.48	8.53
	13	0.71	6.74	0.78	7.11	0.88	6.74	0.87	6.74
	19	0.65	4.27	0.85	4.41	0.88	8.00	0.87	8.53
8	01	0.51	4.41	0.80	5.33	0.82	5.33	0.82	5.33
	07	0.74	5.12	0.94	4.92	0.95	9.14	0.94	9.14
	13	0.52	9.14	0.84	9.84	0.96	8.53	0.95	8.53
	19	0.44	8.53	0.81	8.53	0.93	9.14	0.92	9.14
9	01	1.14	4.92	1.14	5.12	1.24	9.14	1.22	9.14
	07	1.39	6.09	1.36	6.40	1.39	6.40	1.38	6.40
	13	1.24	5.56	1.31	5.33	1.33	5.82	1.31	5.82
	19								
10	01								
	07	1.29	10.66	1.61	10.66	1.69	10.66	1.67	10.66
	13	1.08	11.64	1.26	10.66	1.34	10.66	1.32	10.66
	19	0.74	10.66	0.94	10.66	0.97	9.84	0.95	9.84
11	01	0.37	11.64	0.71	10.66	0.79	10.66	0.78	10.66
	07	0.57	10.66	0.85	10.66	0.87	10.66	0.86	10.66
	13	0.50	4.41	0.72	9.84	0.78	9.84	0.84	9.84
	19	0.42	4.41	0.73	10.24	0.62	10.24	*	

* Electronic problems

TABLE 3: WAVE DATA

Part 2

FEB 1987

Day	Hour	645		625		640		630	
		Baylor Hmo(m)	at 7+80 T(sec)	Baylor Hmo(m)	at 19+00 T(sec)	Nearsh Hmo(m)	Wvrdr T(sec)	Farshr Hmo(m)	Wvrdr T(sec)
12	01	0.33	10.66	0.48	9.84	0.50	9.48	0.51	9.48
	07	0.23	9.84	0.40	8.53	0.43	8.53	0.50	7.76
	13	0.24	13.48	0.42	7.76	0.42	8.83	0.45	7.53
	19	0.24	12.80	0.31	9.14	0.35	8.53	0.38	5.82
13	01	1.19	5.12	1.11	5.12	1.15	5.12	1.46	5.45
	07	0.87	5.56	0.85	5.56	0.89	5.45	1.11	5.69
	13	0.88	4.57	0.85	5.33	0.88	7.32	0.98	7.11
	19	0.96	5.12	1.05	6.92	1.12	6.40	1.24	6.92
14	01	0.78	5.56	0.80	7.76	0.78	8.00	0.87	8.26
	07	0.46	6.24	0.66	6.92	0.68	9.84	0.83	10.24
	13	0.58	5.33	0.64	9.48	0.64	9.48	0.78	7.76
	19	0.49	5.56	0.64	9.48	0.70	8.53	0.81	8.83
15	01	0.72	5.33	0.68	5.69	0.69	8.83	0.87	6.09
	07	1.29	5.22	1.19	5.22	1.26	5.12	1.49	5.12
	13	1.29	6.09	1.64	6.40	1.62	6.24	2.05	6.09
	19	1.18	6.74	1.31	7.11	1.36	6.74	1.62	6.92
16	01	1.31	4.92	1.45	4.83	1.46	5.02	1.71	4.66
	07	1.38	5.82	1.62	5.82	1.67	5.69	2.00	5.69
	13	1.28	7.11	1.54	7.11	1.64	6.92	1.87	6.57
	19	1.48	6.57	2.10	6.40	2.05	6.09	2.51	6.24
17	01	1.43	7.32	2.79	7.11	3.08	7.53	3.41	7.53
	07	1.62	8.26	3.27	8.53	3.94	8.83	5.09	8.53
	13	1.65	9.84	3.00	9.84	*		4.08	9.14
	19	1.59	10.24	2.73	9.48	2.93	10.24	3.15	9.84
18	01	1.54	9.48	2.41	9.84	2.49	9.48	2.88	10.24
	07	1.43	6.92	2.07	10.24	2.25	9.84	2.46	9.84
	13	1.24	5.56	1.64	9.84	1.66	9.84	2.02	9.48
	19	1.00	5.45	1.23	9.48	1.28	8.00	1.52	9.14
19	01	0.77	5.56	0.99	8.83	1.01	9.14	1.25	9.14
	07	0.84	4.13	1.13	9.48	1.15	9.84	1.39	9.14
	13	1.03	5.56	1.14	5.69	1.22	8.53	1.56	5.56
	19	0.95	6.40	1.02	6.40	0.98	5.95	1.30	6.24
20	01	0.78	6.09	0.87	7.11	0.88	6.74	1.08	6.74
	07	1.20	5.56	1.18	6.40	1.18	6.40	1.52	5.95
	13	1.02	5.56	1.00	5.95	0.99	6.09	1.51	6.57
	19	1.02	6.40	0.93	6.92	0.92	7.32	1.15	6.40
21	01	0.65	5.82	0.68	5.95	0.71	6.40	0.82	5.82
	07	0.65	5.82	0.63	6.40	0.65	5.82	0.85	6.40
	13	0.66	5.33	0.69	6.09	0.77	6.24	0.92	6.24
	19	0.82	5.69	0.73	5.56	0.78	5.82	0.92	5.82
22	01	0.55	5.45	0.65	8.00	0.69	7.53	0.84	8.26
	07	0.56	5.12	0.60	8.83	0.63	8.53	0.64	8.26
	13	0.54	5.22	0.65	8.00	0.69	8.53	0.74	8.26
	19	0.69	2.61	0.73	4.27	0.79	7.53	0.87	7.53

* Electronic problems

TABLE 3: WAVE DATA

Part 3

FEB 1987

Day	Hour	645		625		640		630	
		Baylor at 7+80 Hmo(m)	T(sec)	Baylor at 19+00 Hmo(m)	T(sec)	Nearshr Hmo(m)	Wvrdr T(sec)	Farshr Hmo(m)	Wvrdr T(sec)
23	01	0.77	6.74	0.99	6.74	1.08	6.74	1.45	6.40
	07	0.95	3.88	0.95	8.00	1.05	8.53	0.82	2.78
	13	1.55	7.11	1.82	7.53	1.85	7.11	*	
	19	1.46	10.66	1.85	10.24	1.83	10.24	2.02	10.66
24	01	1.41	11.64	1.80	11.14	1.79	11.14	1.72	10.66
	07	1.32	11.14	1.52	11.64	1.53	11.14	1.53	11.64
	13	1.23	11.14	1.37	10.66	1.40	10.24	1.51	10.66
	19	0.99	12.80	1.19	12.20	1.18	11.64	1.28	11.14
25	01	0.79	11.14	1.01	11.14	1.08	11.14	1.03	11.64
	07	0.67	12.20	0.91	11.64	0.92	12.20	0.82	11.14
	13	1.18	5.56	1.35	5.82	1.38	5.56	1.49	5.82
	19	1.09	5.82	1.15	12.20	1.17	12.20	1.28	12.80
26	01	1.10	6.24	1.11	12.80	1.12	12.80	1.24	5.33
	07	1.07	5.69	1.23	13.48	1.27	13.48	1.38	6.40
	13	1.24	4.92	1.24	12.80	1.21	12.80	1.45	12.80
	19	0.95	5.82	1.12	12.80	1.14	12.80	1.20	12.80
27	01	0.91	6.40	1.02	12.20	1.05	12.20	1.16	6.74
	07	0.84	6.40	1.09	11.64	1.10	6.40	1.22	7.11
	13	1.00	5.12	1.14	9.14	1.13	9.14	1.19	5.56
	19	0.83	4.74	1.11	9.14	1.10	9.14	1.29	5.12
28	01	1.06	5.56	1.24	10.24	1.27	10.24	1.46	6.40
	07	1.19	5.45	1.61	5.22	1.64	5.56	1.86	5.69
	13	1.23	11.14	1.50	10.24	1.58	10.66	1.64	5.95
	19	1.02	11.64	1.50	11.64	1.62	11.64	1.67	7.11
Mean		0.87	7.09	1.07	8.51	1.11	8.45	1.24	7.90
Std dev		0.39	2.84	0.55	2.57	0.57	2.19	0.73	2.09

* Electronic problems

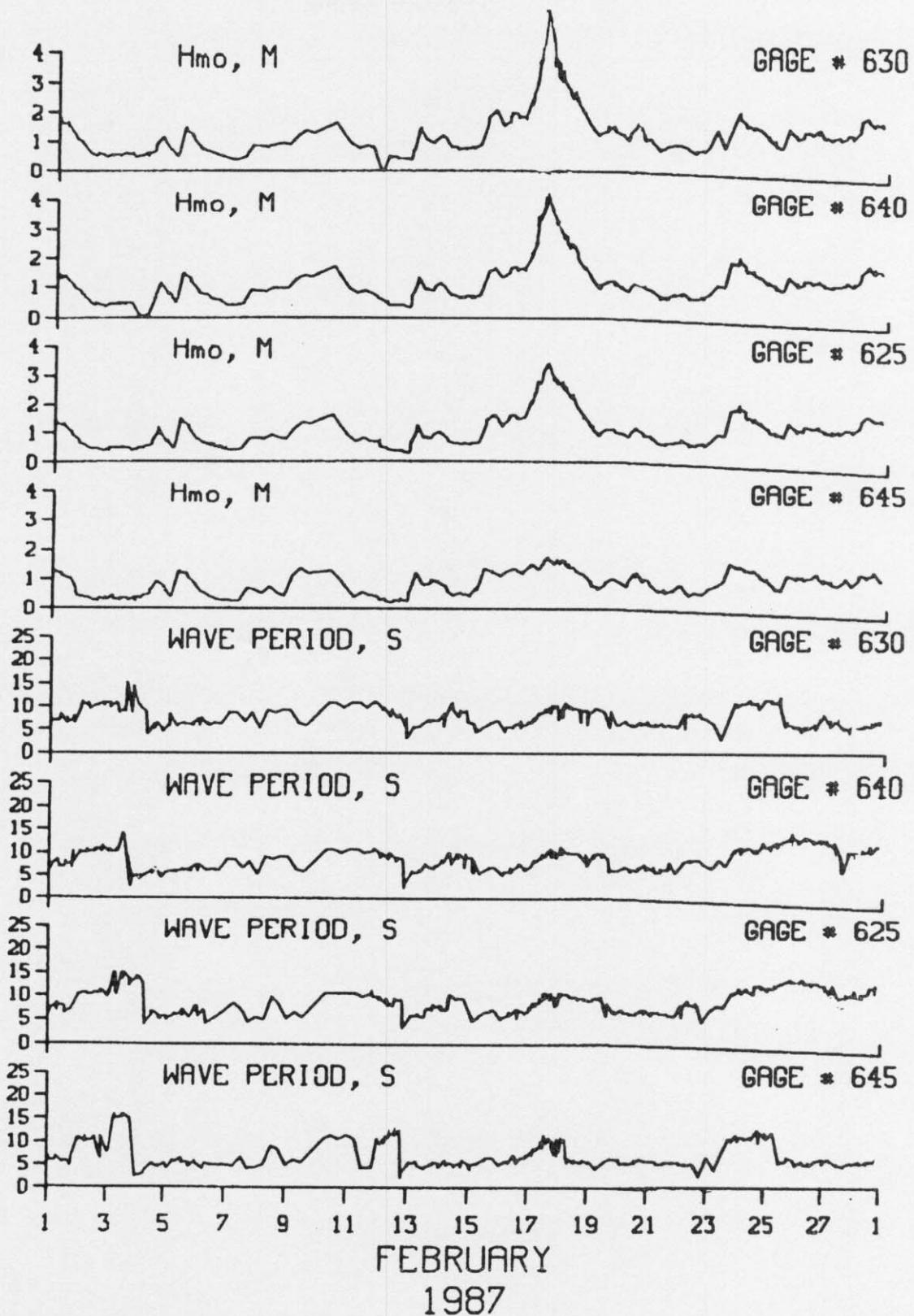


FIGURE 3. Time History of Wave Heights and Periods

IV. CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, alongshore currents flow either toward 340 (i.e. northward) or toward 160 (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second.

TABLE 4: Current Data
FEB 1987

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter at South Tripod	
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed
1	0100-Along Cross Result									22	S
										5	on
										23	173
1	0700-Along Cross Result	36 9 off	165		61 12 off	149			North	64	S
		37 146			62					13 5 14	on 181
1	1300-Along Cross Result									16 3 16	S on 171
1	1900-Along Cross Result									4 6 7	N off 36
2	0100-Along Cross Result									4 1 4	N on 326
2	0700-Along Cross Result	20 10 off	152		12 4 off	357			South	9	N
		23 7			13					11 4 12	N off 360
2	1300-Along Cross Result									10 3 10	N off 357
2	1900-Along Cross Result									7 4 8	N off 10
3	0100-Along Cross Result									1 2 2	S on 223
3	0700-Along Cross Result	22 3 off	189		16 4 off	354			South	2	N
		22 349			16					7 4 8	N off 10
3	1300-Along Cross Result									12 2 12	N on 331
3	1900-Along Cross Result									12 2 12	N on 331
4	0100-Along Cross Result									1 8 8	N on 257
4	0700-Along Cross Result	10 0 S	165		29 1 off	157			North	12	S
		10 160			29					3 3 4	N off 25
4	1300-Along Cross Result									15 5 16	S on 178
4	1900-Along Cross Result									18 6 19	S on 178
5	0100-Along Cross Result									17 7 18	S on 182
5	0700-Along Cross Result	36 4 S on	262		41 4 S on	166			North	50	S
		36 166			41					33 6 34	S on 170
5	1300-Along Cross Result									22 2 22	S on 165
5	1900-Along Cross Result									19 1 19	S on 163

KEY = All speeds in CM/SEC

N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

TABLE 4: Current Data
FEB 1987

Day	Time	Pier Measurements				Beach Measurements				Current Meter			
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	(500m Updrift)	Dye 12m offshore (surface)	Location	Speed	Dir
6	0100-Along Cross Result									7	S	on	176
6	0700-Along Cross Result	10 5 11	S on 187		165	5 12 13	S off 92		North	18	S	1 3 3	S on 232
6	1300-Along Cross Result											10 1 10	N off 346
6	1900-Along Cross Result									4 1 4		N off 354	
7	0100-Along Cross Result									6 2 6		S off 142	
7	0700-Along Cross Result	14 3 14	S on 174		177	22 7 23	N off 357		North	6	N	4 1 4	S off 146
7	1300-Along Cross Result									10 0 10		S	
7	1900-Along Cross Result									8 3 9		S off 139	
8	0100-Along Cross Result									1 1 1		N off 25	
8	0700-Along Cross Result	6 3 7	S off 131		165	19 12 23	N off 13		South	15	N	4 0 4	S 160
8	1300-Along Cross Result									7 0 7		N 340	
8	1900-Along Cross Result									4 1 4		N off 354	
9	0100-Along Cross Result									22 0 22		S	
9	0700-Along Cross Result	41 20 45	S off 133		238	61 18 64	S off 143		North	49	S	36 2 36	S on 163
9	1300-Along Cross Result									32 7 33		S off 148	
9	1900-Along Cross Result												
10	0100-Along Cross Result												
10	0700-Along Cross Result	22 0 22	S off 160		274	34 5 34	S off 151		no observation	19 3 19		S on 169	
10	1300-Along Cross Result									10 3 10		S on 177	
10	1900-Along Cross Result									10 1 10		S on 166	

KEY = All speeds in CM/SEC
 N = Northward, Shore parallel
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 on = onshore off = offshore

TABLE 4: Current Data
FEB 1987

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements				Current Meter			
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	(500m Updrift)	Dye 12m offshore (surface)	Location	Speed	Dir
11 0100	Along Cross Result									10	S		
										6	on		
										12		191	
11 0700	Along Cross Result	5 3 6	S off 129		38 10 39	S off 146			North	3	S	15 10 18	S on 194
11 1300	Along Cross Result									4	N		
										4	off		
										6	25		
11 1900	Along Cross Result									4	S		
										1	off		
										4	146		
12 0100	Along Cross Result									6	N		
										2	off		
										6	358		
12 0700	Along Cross Result	21 5 22	N off 354		140	8 1 8	N off 349		South	7	N	10 0 10	N 340
12 1300	Along Cross Result									14	N		
										3	off		
										14	352		
12 1900	Along Cross Result									11	N		
										1	on		
										11	335		
13 0100	Along Cross Result									22	S		
										3	on		
										22	168		
13 0700	Along Cross Result	4 0 4	S off 157		152	15 9 18	S off 129		North	40	S	13 3 13	S on 173
13 1300	Along Cross Result									6	S		
										6	on		
										8	205		
13 1900	Along Cross Result									11	S		
										7	on		
										13	192		
14 0100	Along Cross Result									7	S		
										5	on		
										9	196		
14 0700	Along Cross Result	15 3 15	S on 171		140	7 7 9	S off 115		North	6	S	6 3 7	S on 187
14 1300	Along Cross Result									21	S		
										2	off		
										21	155		
14 1900	Along Cross Result									17	S		
										4	off		
										17	147		
15 0100	Along Cross Result									37	S		
										6	on		
										37	169		
15 0700	Along Cross Result	76 23 80	S on 177		226	61 18 64	S on 177		North	53	S	37 0 37	S 160
15 1300	Along Cross Result									41	S		
										9	on		
										42	172		
15 1900	Along Cross Result									15	S		
										2	off		
										15	152		

KEY = All speeds in CM/SEC

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

TABLE 4: Current Data
FEB 1987

Day	Time	Pier Measurements				Beach Measurements				Current Meter	
		Dye at (579 m) Speed	Dye at (surface) Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	at South Tripod
16	0100-Along Cross Result									38	S
										4	on
										38	166
16	0700-Along Cross Result	34 3 34	S on 166	262	51 10 52	S on 171	North	61	S	36 0 36	S 160
16	1300-Along Cross Result									31 3 31	S on 166
16	1900-Along Cross Result									35 2 35	S on 163
17	0100-Along Cross Result									59 14 61	S on 173
17	0700-Along Cross Result	102 76 127	S off 123	311	152 0 152	S 160	no observation			78 27 83	S on 179
17	1300-Along Cross Result									55 19 58	S on 179
17	1900-Along Cross Result									38 12 40	S on 178
18	0100-Along Cross Result									55 8 56	S on 168
18	0700-Along Cross Result	0 0 0		226	44 0 44	S 160	no observation			34 5 34	S on 168
18	1300-Along Cross Result									30 1 30	S on 162
18	1900-Along Cross Result									16 4 16	S on 174
19	0100-Along Cross Result									27 4 27	S on 168
19	0700-Along Cross Result	44 7 44	S on 169	152	76 30 82	S off 138	North	22	S	25 5 25	S on 171
19	1300-Along Cross Result									31 5 31	S on 169
19	1900-Along Cross Result									30 4 30	S on 168
20	0100-Along Cross Result									26 5 26	S on 171
20	0700-Along Cross Result	61 6 61	S on 166	177	55 42 69	S on 197	North	61	S	24 5 25	S on 172
20	1300-Along Cross Result									26 3 26	S on 167
20	1900-Along Cross Result									14 7 16	S on 187

KEY = All speeds in CM/SEC

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

TABLE 4: Current Data
FEB 1987

Day	Time	Pier Measurements				Beach Measurements			Current Meter	
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	(500m Updrift)	South Tripod Depth -4.8m (NGVD)
21	0100-Along Cross Result									7 N on 332
21	0700-Along Cross Result	28 4 28	S on 169		152	47 9 48	S on 171		North 39 S	17 4 17
21	1300-Along Cross Result									9 S on 202
21	1900-Along Cross Result									14 S on 180
22	0100-Along Cross Result									6 S off 115
22	0700-Along Cross Result	25 4 26	S off 151		152	36 4 36	S off 154		North 18 S	14 5 15
22	1300-Along Cross Result									12 6 13
22	1900-Along Cross Result									6 S on 169
23	0100-Along Cross Result									5 N on 251
23	0700-Along Cross Result	55 6 56	S off 154		177	102 0 102	S 160		North 91 S	20 3 20
23	1300-Along Cross Result									37 2 37
23	1900-Along Cross Result									27 6 28
24	0100-Along Cross Result									14 3 14
24	0700-Along Cross Result	51 0 51	S 160		250	34 7 35	S on 171		North 59 S	28 5 28
24	1300-Along Cross Result									22 1 22
24	1900-Along Cross Result									19 3 19
25	0100-Along Cross Result									8 S on 197
25	0700-Along Cross Result	68 0 68	S 160		165	34 17 38	S on 187		North 24 S	35 3 35
25	1300-Along Cross Result									30 6 31
25	1900-Along Cross Result									39 S on 164

KEY = All speeds in CM/SEC

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

TABLE 4: Current Data
FEB 1987

Day	Time	Pier Measurements				Beach Measurements				Current Meter	
		Alongshore Cross-shore Resultant Speed	Dye at (579 m) (surface)	Distance from Baseline (m)	Speed	Dir	(500m Updrift)	Dye 12m offshore (surface)	Location	Speed	Dir
26	0100-Along Cross Result									28	S
										4	on
										28	168
26	0700-Along Cross Result	61 3	S on	189	41 71 82	S on 220	no observation			15 3 15	S on 171
26	1300-Along Cross Result									24 2 24	S on 165
26	1900-Along Cross Result									26 2 26	S on 164
27	0100-Along Cross Result									15 7 17	S on 185
27	0700-Along Cross Result	38 8 39	S on 171	152	51 3 51	S off 157	North	36	S	18 6 19	S on 178
27	1300-Along Cross Result									17 4 17	S on 173
27	1900-Along Cross Result									19 10 21	S on 188
28	0100-Along Cross Result									28 7 29	S on 174
28	0700-Along Cross Result	0 23 23	on 250	165	17 8 19	N off 7	South	24	N	17 4 17	S on 173
28	1300-Along Cross Result									4 4 6	S on 205
28	1900-Along Cross Result									11 1 11	S off 155

KEY = All speeds in CM/SEC
N = Northward, Shore parallel
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on = onshore off = offshore

V. SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) taken at the seaward end of the pier are made of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves) but not surface chop or capillary waves. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring alignment of the wave crests. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 east of true north; consequently, wave angles greater than 70 imply the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are made daily at the seaward end of the FRF pier. A jar along with a thermometer is lowered about .3 m (1 ft) into the water and allowed to remain for at least one minute. The jar is removed, the temperature read and a hydrometer is used to determine the density. A secci disc is used to determine the surface visibility.

TABLE 5
SUPPLEMENTAL OBSERVATIONS

FEB 1987

DAY	TIME	WAVE APPROACH ANGLE		RADAR WAVE ANGLE deg from True N	WIDTH OF SURF ZONE(m)	WATER CHARACTERISTICS		
		AT PIER END deg from True N	Primary Secondary			AT PIER END	DENSITY (g/cc)	SECCI VIS(m)
1	950	55			116	3.5	1.0222	1.2
2	751	125			12	4.2	1.0234	0.6
3	715		110		104	4.4	1.0233	1.8
4	715	20		20	94	4.5	1.0234	2.4
5	715	20	60	25	311	4.0	1.0218	1.2
6	715	60			116	3.7	1.0204	2.4
7	930	90			128	4.7	1.0202	1.8
8	930	90	55		93	4.7	1.0204	1.5
9	800	25		25	137	4.5	1.0204	1.2
10	715	50		60	341	3.5	1.0242	0.3
11	752	90			163	4.0	1.0228	2.7
12	726	150			12	4.0	1.0230	2.4
13	730	25			149	4.4	1.0234	2.4
14	900	55			19	4.9	1.0232	1.8
15	800	20		25	152	4.5	1.0208	1.2
16	715	50			363	2.7	1.0223	0.3
17	800	60		65	460	2.2	1.0224	0.9
18	730	100		10	469	3.4	1.0212	0.3
19	850	50	30		101	3.7	1.0236	0.6
20	900	50			110	3.0	1.0220	0.6
21	915	60			78	3.2	1.0204	1.8
22	930	50	90		76	3.2	1.0202	1.8
23	800	50		25	168	3.7	1.0242	0.6
24	740	30	70	30	317	3.6	1.0236	0.3
25	730	80	45	80	174	3.6	1.0225	1.5
26	737	50	70	50	189	3.7	1.0214	1.2
27	737	20	70	30	439	3.8	1.0217	1.5
28	853	80		80	155	4.2	1.0202	1.2

VI. WATER LEVELS

The National Ocean Services (NOS) has established a primary tide station (No. 865- 1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect data every 6 minutes throughout the month.

Figure 4 shows the variation in mean water levels computed over a tidal cycle period (12.42 hours), and contains a list of selected mean and extreme values. This presentation is useful in identifying effects on both meteorological and astronomical forces on the open coast water levels.

Table 6 contains the time of the center of each sampling interval and the range, high, low, and mean water levels during each tidal cycle.

FRF TIDE HEIGHTS
FEB 1987

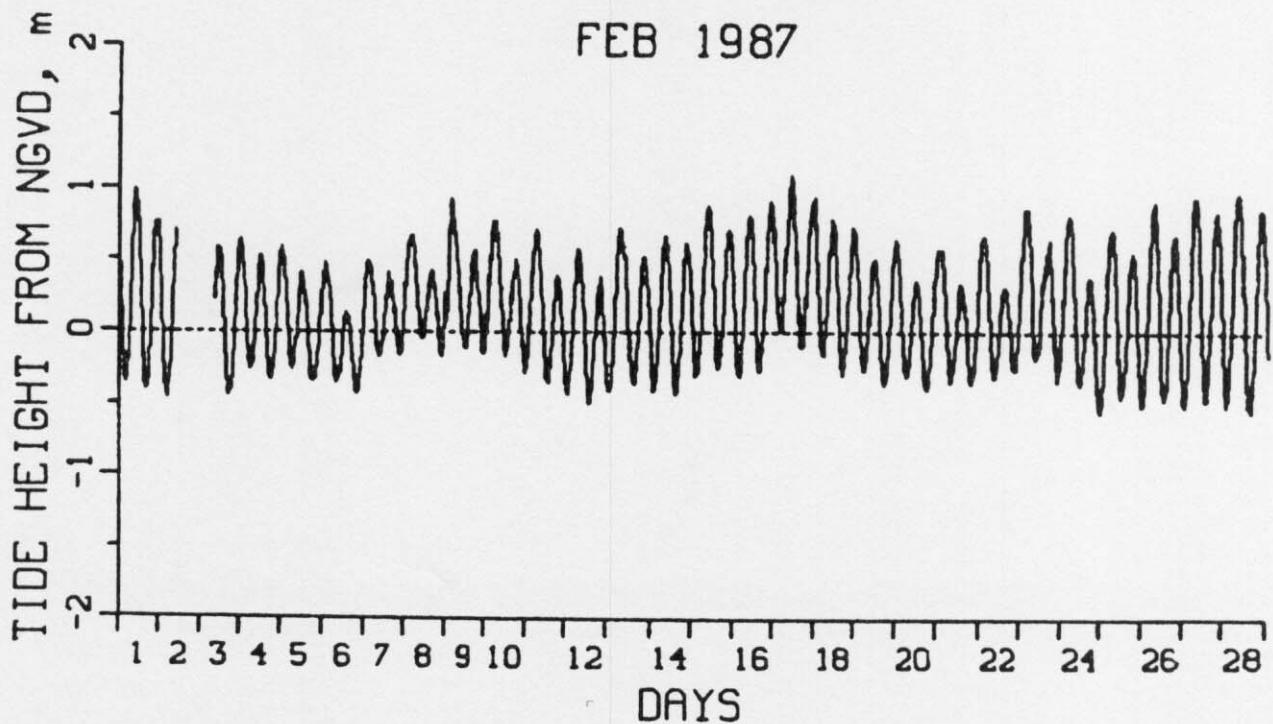


FIGURE 4. Time History of Mean Water Levels, February 1987

MONTHLY MEAN WATER LEVELS (METERS MSL)

Extreme Low -	-0.55 on 24 February at 2236 hrs.
Extreme High -	1.08 on 17 February at 0936 hrs.
Monthly Mean -	0.17
Mean Low Water -	-0.32
Mean High Water -	0.65
Mean Range -	0.97

TABLE 6
WATER LEVELS (METERS MSL)
 Tidal Characteristics

	MID-CYCLE DAY	LOW TIME	HIGH	MEAN	RANGE
1	612	-0.35	0.98	0.32	1.34
1	1837	-0.41	0.76	0.19	1.16
3	2018	-0.43	0.63	0.10	1.07
4	843	-0.26	0.53	0.12	0.79
4	2109	-0.33	0.59	0.12	0.92
5	934	-0.25	0.41	0.08	0.66
5	2159	-0.34	0.48	0.05	0.82
6	1024	-0.35	0.14	-0.09	0.48
6	2249	-0.43	0.49	0.03	0.92
7	1115	-0.17	0.41	0.11	0.58
7	2340	-0.16	0.67	0.27	0.83
8	1205	-0.05	0.46	0.21	0.51
9	30	-0.17	0.92	0.33	1.09
9	1255	-0.12	0.59	0.23	0.70
10	121	-0.15	0.76	0.32	0.91
10	1346	-0.16	0.51	0.20	0.67
11	211	-0.28	0.70	0.22	0.98
11	1436	-0.35	0.39	0.04	0.74
12	301	-0.42	0.57	0.06	0.99
12	1527	-0.49	0.38	-0.06	0.87
13	352	-0.41	0.71	0.15	1.12
13	1617	-0.36	0.53	0.09	0.89
14	442	-0.41	0.67	0.14	1.08
14	1707	-0.43	0.61	0.11	1.04
15	532	-0.30	0.87	0.28	1.17
15	1758	-0.25	0.71	0.24	0.95
16	623	-0.31	0.80	0.25	1.11
16	1848	-0.27	0.91	0.33	1.18
17	713	0.01	1.08	0.51	1.07
17	1938	-0.11	0.93	0.40	1.04
18	804	-0.16	0.79	0.30	0.94
18	2029	-0.29	0.73	0.23	1.02
19	854	-0.26	0.50	0.11	0.77
19	2119	-0.36	0.63	0.14	0.99
20	944	-0.30	0.36	0.02	0.66
20	2210	-0.39	0.57	0.11	0.97
21	1035	-0.34	0.33	0.00	0.67
21	2300	-0.35	0.66	0.18	1.01
22	1125	-0.31	0.32	0.02	0.63
22	2350	-0.26	0.85	0.30	1.11
23	1216	-0.18	0.64	0.20	0.82
24	41	-0.34	0.80	0.25	1.15
24	1306	-0.37	0.38	0.02	0.75
25	131	-0.55	0.71	0.08	1.26
25	1356	-0.45	0.55	0.05	0.99
26	222	-0.51	0.91	0.17	1.42
26	1447	-0.45	0.67	0.12	1.12
27	312	-0.51	0.93	0.21	1.44
27	1537	-0.47	0.83	0.19	1.30
28	402	-0.51	0.96	0.24	1.47
28	1628	-0.55	0.85	0.18	1.40

VII. NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in January and the three surveys taken during February on profile line 188, located 517 m south of the pier. Prior to a storm on 16-18 February, several significant changes are visible on the profile. Accretion occurred on both the foreshore (80 to 120 m) and on the seaward face of the storm bar (380 to 560 m). Following the storm, the nearshore bar (160 to 180 m) migrated 30 m seaward with only minor changes to the remainder of the profile.

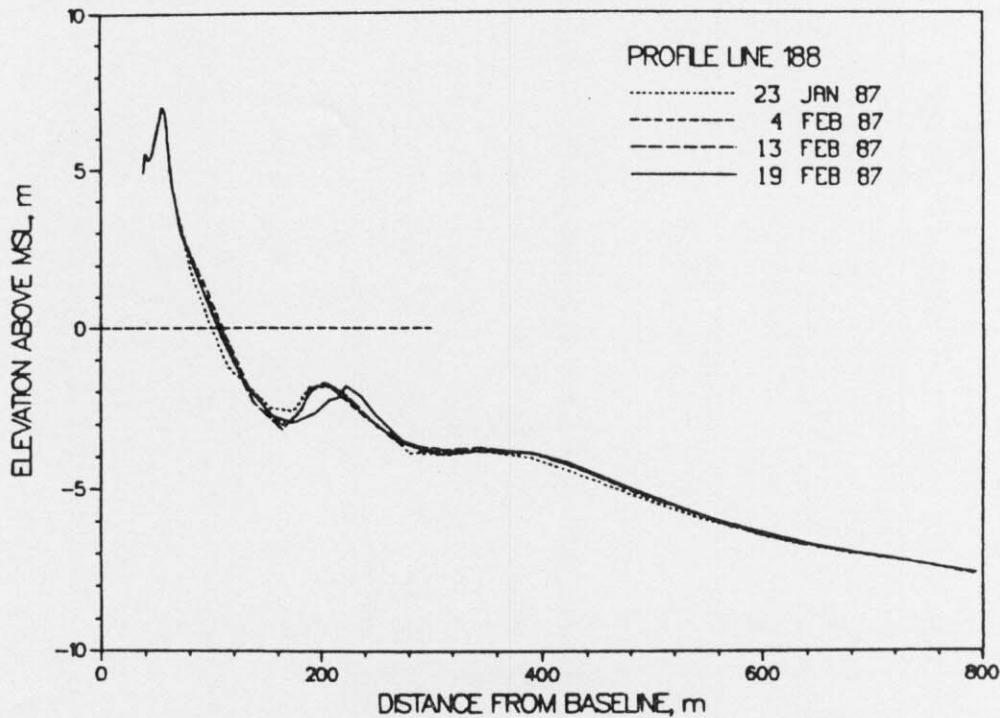


Figure 5. Monthly CRAB profiles on profile 188 - 517 meters south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile between January and February. The changes to the foreshore (110 to 125 m) and to the storm bar (380 to 500 m) depict the accretion prior to the 16-18 February storm while the changes to the nearshore bar (150 to 310 m) were caused by the storm.

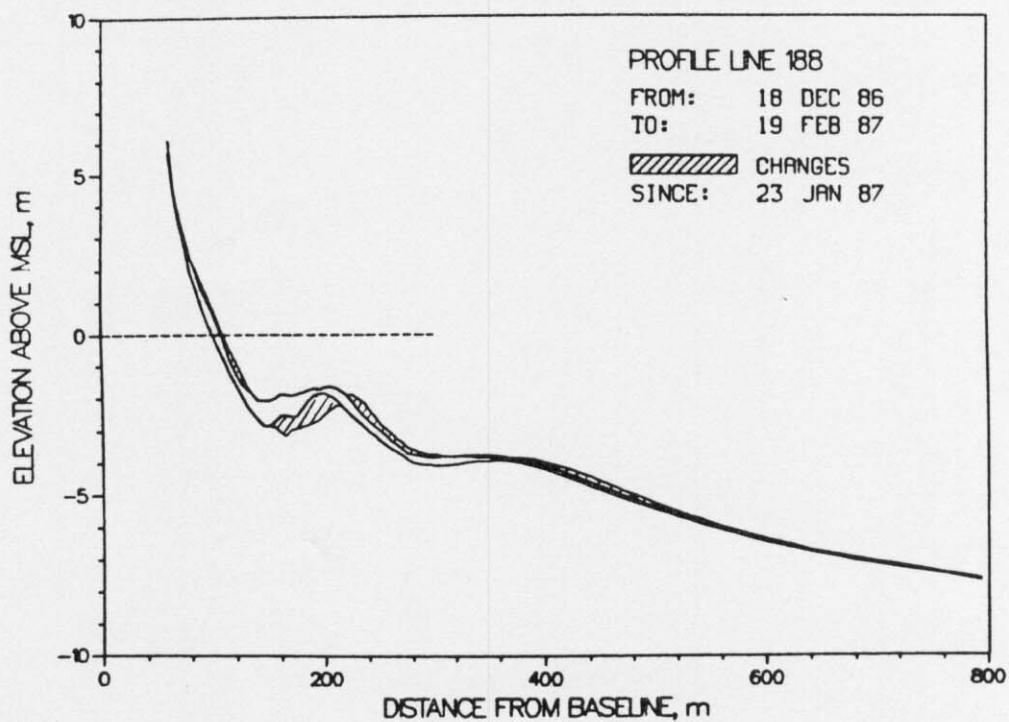


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. No bathymetric survey was conducted in February. The December bathymetric survey is given for reference.

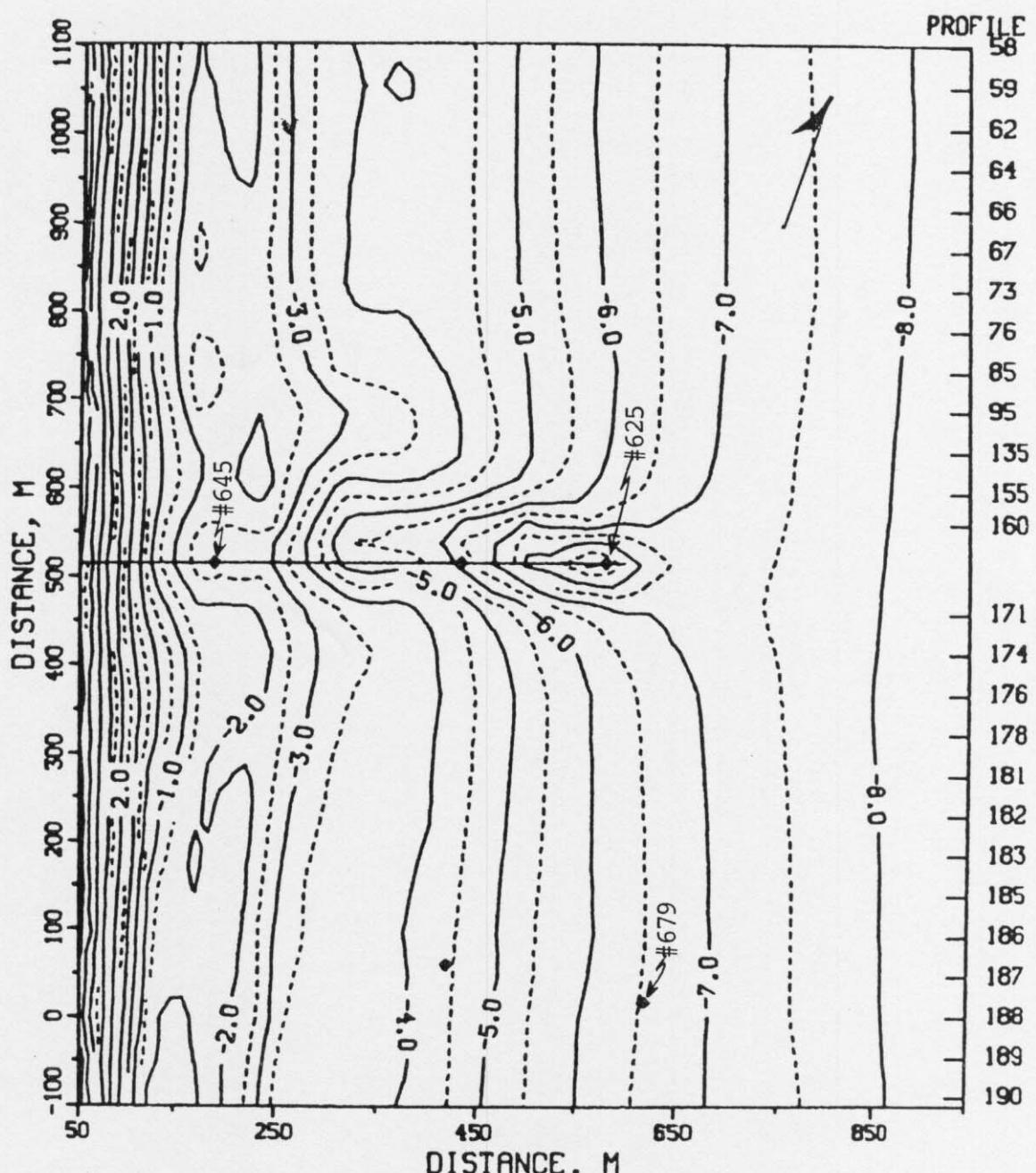


Figure 7. FRF BATHYMETRY 5 DEC 86
CONTOURS IN METERS

VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the wave height at the seaward end of the pier (i.e. as measured by the Baylor Gage #625 at pier station 19+00) exceeded 2 m. When this occurred, four contiguous 34-min wave records were obtained every hour:

<u>Start</u>	<u>End</u>
16 February (1900)	18 February (0700)

B. Storm Synopsis.

16-18 February - Northeast winds generated by a strong Canadian high pressure system first affected the FRF early on 16 February following the passage of a cold front. Maximum onshore winds (NNE) approached 18 m/s at 0508 hrs on 17 February and the maximum H_{mo} (at Gage #625) of 3.42 m (Tp = 8.83 sec) was recorded at 0342 hrs on the same day. Total precipitation was 27 mm.

Distribution List

Government Agencies:

OCE
BERH
NAO
NASA/Wallops Flight Center
NOAA (NOS, NWS)
SAD
SAW

U.S. Geological Survey
U.S. National Park Service
U.S. Naval Academy
U.S. Naval Civil Eng. Lab
U.S. Naval Fac. Eng. Com.
U.S. Naval Oceanographic Off.
U.S. Naval Research Lab

Colleges/Universities:

California Inst. of Tech.
East Carolina University
Florida Inst. of Tech.
Harvard University
Naval Post Graduate School
NC State University
Old Dominion University
Oregon State University
Prince George's College
Rutgers University
Scripps Inst. of Oceanography
Southern Illinois University

Stockton State College
University of Akron
University of Delaware
University of Florida
University of Maryland
University of Miami
University of North Carolina
University of N. Colorado
University of Rhode Island
University of Virginia
Va. Inst. of Marine Science

Others:

City of Va. Beach, VA
Coastal Barge Corporation
Coastal and Est. Res., Inc.
Coastal Science & Eng., Inc.
Cedar Ocean Sensors Ltd.
Dr. Galvin
GEOMET Tech., Inc.
Greenhorne & O'Mara, Inc.
Dr. Hylton
Mary Marr, Inc.
Masonite Corporation

MEC Systems Corporation
Moffatt & Nichol, Eng.
Offshore Coastal Technologies
Mr. Rowland
Mr. Savage
Sea Port Supply Corp.
Shell Development
Sherwood Industries
Sohio Petroleum Co.
Mr. & Mrs. Valpey
WCTI-TV

Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)
Queen's University, Ontario (Canada)
Ministry of Construction, Coastal Division (Japan)
Norwegian Hydrodynamic Laboratories (Norway)
University of New South Wales (Australia)
University of Sydney (Australia)